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Examples from Northern Italy

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Irrigation systems as common-pool resources

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Giangiaco­mo Bravo and Beatrice Marelli

- 1 Common-pool resources (CPRs) are natural or man-made resources shared among different users, a condition that produces a competition for their utilization leading often (although not necessarily) to their degradation or even to their destruction. A vast number of valuable natural resources falls in this category and shows today “chronic” problems of overuse. Examples are the world forests, fisheries, water basins, biodiversity and even the atmosphere. Nevertheless, in contrast with previous theoretical predictions including Hardin (1968) influential work on the “tragedy of the commons”, a vast number of empirical researches, and especially Ostrom (1990) seminal work, have shown the possibility of a successful endogenous management of CPRs and explained theoretically how this achievement is possible.
- 2 This paper shortly discusses the “theory of the commons” as developed in the last 20 years by Elinor Ostrom and her colleagues (e.g Ostrom, 1990, 2005; Ostrom et al., 1994, 2002) and illustrates it by mean of case studies regarding a number of irrigation systems in Northern Italy (Lombardy and Vallée d’Aoste). Our main goal is to present the role that different social mechanisms play in influencing the outcomes of the institutional schemes for the commons management. The paper is organized as follows: section 2 introduces the theoretical background underlying CPR research; section 3 presents the empirical research; section 4 discusses our findings and draws the conclusions.

Theoretical background

- 3 Formally, the expression common-pool resource refers to a class of goods defined by two characteristics: a difficult exclusion of potential beneficiaries and a high degree of subtractability (i.e. rivalry of consumption) (Ostrom et al., 1994, 6–8). Thus, the CPRs share characters with both the private and the public goods, namely a high subtractability with the former ones and a low possibility of exclusion with the latter

ones (Figure 1). This makes the management of CPRs especially complex: as in the private good case, the subtraction of resource units from the commons (e.g. timber from a forest, water from a basin, etc.) done by one user reduces the total quantity of units available for the other users; as in the public good case, it is difficult to prevent any user from continue to subtract units from an endangered resource (e.g. the ocean fisheries). This led Hardin (1968) to depict the commons problem by means of a model akin to a Public-good game, i.e. a n players version of the well known Prisoner's dilemma. What is especially important is that, being the CPR problem a Public-good game, there are no rational incentives for any user to limit his/her consumption and, hence, the possibility to avoid the resource degradation or destruction is extremely low.

Figure 1. A general classification of goods

		Subtracability	
		Low	Hight
Exclusion	Difficult	Public goods	CPRs
	Easy	Toll goods	Private goods

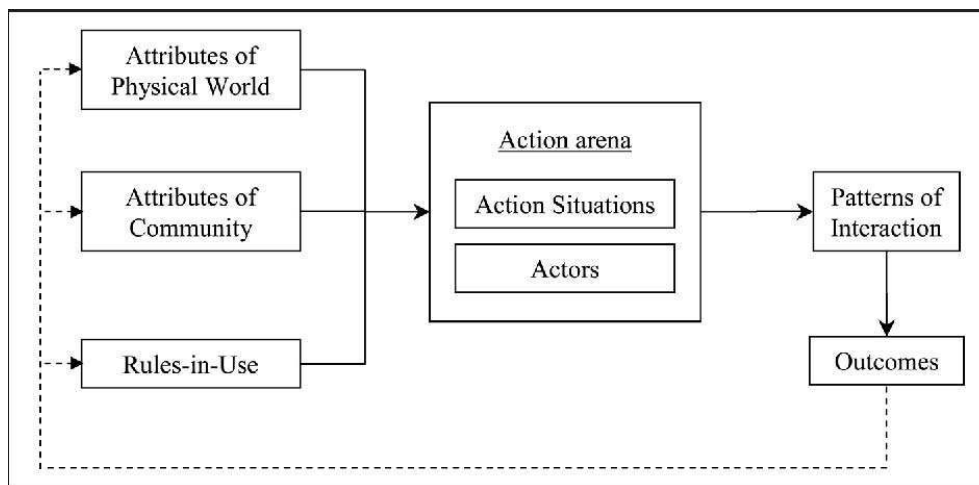
Ostrom et al., 1994, 7.

- 4 Hardin's model applies to a vast number of situations, especially in the case of open-access resources, and it represents a valid explanation of the reason beneath the overuse of common resources done by rational individuals, even when this leads to a significant harm in the long term. Hardin argued consequently for the public management of natural resources. However, subsequent studies showed that, while adequate in some cases, this solution is not always applicable, mainly because of management cost and of information asymmetries. Similarly, the "classic" alternative of dividing and privatizing the resource may help in some cases, but also be inapplicable or suffer of significant shortcomings in other situations (see Ostrom, 1990, 8–13). Moreover, one of the basic findings of Ostrom's work is that many communities across the world actually succeed in solving the Hardin's dilemma and sustainably manage their common resources by building small scale institutions, well adapted to the local conditions. This does not imply that the endogenous management represents the solution for CPR problems. The main insight of Ostrom's work is indeed that there is no "only way" to solve commons dilemmas. Endogenous institutions can work well in many situations, but in case of failure it is essential to look for different solutions — e.g. centralized management, private rights, co-management or a combination of different regimes — in order to avoid Hardin's tragedy (Marshall, 2005; Ostrom, 1990, 2005; Ostrom et al., 1994). All those schemes have, however, one point in common: the presence of an institution that defines clear exploitation rights and creates the right incentives in order to avoid overuse. In other words, the tragedy of the commons is the tragedy of open-access resources, not necessarily the one for well managed CPRs.
- 5 Subsequent works expanded Ostrom's insights. Being impossible to explore the details of the overwhelming vast literature on the commons, we will focus here on three important developments: (I) the study of institutional dynamics and the interplay between institutions and shared values; (II) the linking of CPR literature with ecological analysis; (III) the analysis of resource management on wider scales, including the global one.
- 6 I) The study of institutional dynamics investigates how institutional change is affected by a number of factors including collaborative environmental management, i.e. based on the

attributes of the community called to solve collective action situations (e.g. Connors and Dovers 2004; Marshall, 2005; Young, 2002). Since our paper basically adopt this approach, will be discuss it in details later.

- 7 II) CPR management literature has recently developed in the direction of an increasing relationship with ecological studies. This happened mainly through to the concept of social-ecological system, an expression that emphasizes the linkages existing between humans and the natural systems where they live. Social-ecological system literature resulted in a wide number of theoretical and empirical works that studied a vast variety of management practice cases from the point of view of their effects on ecosystem dynamics and their capacity to learn from and to adapt to the feedback coming from the natural environment. Particular attention is devoted to the application of concepts as adaptability, resilience and robustness, first defined by the ecological science and pivotal in explaining the evolution of complex systems (Berkes and Folke, 1998; Berkes et al. 2003; Gunderson and Holling, 2001). This field of inquiry currently represents one of the most interesting new fields in the study of human-environment relationship.
- 8 III) Most of the theoretical work on large scale resources started only in the middle Nineties as direct extension of small-scale CPR research, an approach that led to emphasize the common aspects of the different levels of analysis (e.g. Buck, 1998; Keohane and Levy, 1994). While this approach led to some immediate significant results, it probably under-recognized the important differences linked with the scale increase (especially when considering the global commons) in terms of heterogeneity of the stakeholders, governance capabilities, and constitutional-choice institutional rules (e.g. Paavola, 2008).
- 9 Especially significant for CPR research is the fact that, in the last 15 years, most studies were conducted under a unified scientific scheme: the Institutional Analysis and Development (IAD) framework (Ostrom et al., 1994, Chap. 2). The IAD framework is an important research tool that highlights the basic elements to consider in a CPR study, along with the relations among them (Fig. 2). The framework core is a conceptual unit, the action arena, that includes actors interacting in a social space called action situation. The characters of the actors and of the action situation define the arena, while the interactions among individuals inside the arena produce the outcomes of the institutional arrangement. Three classes of external factors affect the structure and the functioning of action arenas: the states of physical world where actions are undertaken; the rules in use by participants to order their interactions; the structure of the community where participants act.

Figure 2. The IAD framework



Ostrom et al., 1994, 37.

- 10 The irrigation systems represent a nice example of CPRs that were widely studied using the IAD framework (e.g. Lam, 1998; Ostrom, 1992; Tang, 1992; Uphoff, 1986). An irrigation system is actually composed by two different common resources: the channel(s) and the water. Both resources cause (different) collective action problems to their users. The channels pose mainly a provision problem since they need an adequate maintenance whose cost are shared by the users. The water use triggers instead appropriation problems, mainly linked to the division of water among the users and to the techniques employed in order to monitor the respect of the water rights. Despite the difficult task of managing two CPRs at the same time, many communities across the world actually achieved this result. In most cases, this was done by building credible institutions, well adapted to local physical and social conditions and able to create the right incentives in order to push the users to respect the allocation rights and to contribute to the maintenance of the common infrastructure (Ostrom, 1992; Tang, 1992). Without entering the details, it is worth noting that the functioning of the CPR governing institutions are indeed not only dependent from the physical attributes of the resource — e.g. the total amount of water available, the construction material of the channels, etc. — but also from the social characters of the community of users, i.e. the shared values and worldviews and the existing network of social relations (Auer, 2006). The next section will explore the interplay among those different elements by presenting different case studies of irrigation systems located in Northern Italy. First, a comparative research on nine irrigation systems of the Vallée d'Aoste will delineate the relationship existing between the characters of the community of users, the rules employed in order to manage the resource and the outcomes in terms of sustainable water use. Then, a study of a single irrigation system located in the province of Brescia (Lombardy) will deepen the analysis of the interplay between values, trust and institutional performance.

Case studies

The Vallée d'Aoste cases

- 11 Notwithstanding the relative water abundance of the northern part of Italy, the Vallée d'Aoste has an insufficient rainfall regime, with an average of 100 mm per year less than the surrounding area. Furthermore, the rainfalls are mainly concentrated during the Spring and the Autumn, with a very dry summer. Other meteorological and geological characteristics of the territory, like the dry winds and the strong insolation of the mountain southern sides, contribute to the relative aridity of the fields that need intensive artificial irrigation in order to enhance their productivity. Lacking of natural abundant rainfall, the inhabitants of the region have developed since the Middle Age a widespread system of channels capturing the water from the glaciers or from other sources and distributing it in the fields. Notwithstanding the economic and technological developments, most of the systems are still governed by users' associations (consorzi). The associations manage and maintain the centuries-old channels and often make substantial improvements regarding the transportation and distribution techniques.
- 12 The research, conducted a few years ago using the IAD framework as underlying scheme, covered nine irrigation systems located in different areas of the region. Its results will be here only shortly presented since the reader interested in a deeper discussion of the cases can find further data in Bravo (2002). The nine associations presented major differences in terms of both the factors affecting the action arena and the outcomes of the interaction process. Regarding the physical attributes of the resource, the associations differed in terms of dimensions, water availability at the source and channel characteristics (pipelines vs. open-air channels). The associations differed also with respect to both the rules in use for managing water withdrawals and channel maintenance and to the monitoring arrangements. Finally, the association presented marked differences in community characters. With the expression "community characters" we mainly refer to the interplay of two elements: the relationships (especially mutual help relations) existing between users, and the presence of shared values, shared knowledge and shared meanings regarding the different aspects of everyday life and work.
- 13 The external context played also a significant role in influencing the association performances. In the areas where the importance of agricultural practices strongly declined due to the rise of tourism as main economic activity, most of the association members have a main job outside agriculture and give little weight to irrigation problems. On the other hand, in areas enjoying lower tourism development, agriculture and especially animal husbandry maintain a significant economic significance. Nevertheless, those areas often suffer from out-migration and from a consequent increase of the average age of the population. Despite the significant weight that the associations maintain in those areas, they often experience a reduction in membership and, consequently, an increasing difficulty in paying the channel maintenance costs.
- 14 The main result of the research is that, besides the obvious fact that larger water availability at the source helps in reaching an adequate level of irrigation of the plots, the community represents a major factor that influences the outcomes of interaction in the different action arenas and, consequently, the overall performance of the associations.

Stronger communities have higher probabilities to solve the collective action problems linked with water allocation and channel maintenance. This leads to better functioning channels with lower water dispersion, to a greater respect of allocation rules and of water rights, and to a consequent reduction of monitoring costs. On the other hand, having a strong community represents a double-edge sword when the necessity of institutional innovation arises, e.g. because of changes of some resource attributes and/or in the external socio-economic context. A strong community can indeed help in overcoming the collective action problems linked with the institutional change, a fact that actually happened in some of the most successful among of the studied cases. Nevertheless, excessively closed communities, with fundamentally backward looking values and worldviews, tend instead to respond negatively to any innovation hypothesis. In this case, the strength of the community represents a factor that goes against the association interest. A similar situation was actually recorded in, at least, one of the analyzed associations.

The Farfenga case

- 15 Farfenga is the name of a small-scale, self-governed irrigation association located in the Brescia province. Brescia is the most extended province of Lombardy, an Italian region that encompasses the Retican Alps. Although the relative abundance of the rainfall regime of this zone (an average of 1050 mm per year), assurance about constant availability of water is of primary importance for local farmers. At present, the Farfenga association includes about 40 households who grow cereals for the food market and/or for the livestock feeding needs. The majority of these farmers are over 50 years old, since younger members are departing the community in large numbers, so the social reality as a whole is aging. Most of the members are males who hold the land property or who rent it.
- 16 The research found no substantial differences among the Farfenga community members with respect to the main worldviews that frames social daily-life, according with a common culture that comes from the rural tradition of Northern Italy. This implies the respect of an implicit moral code, related to work relationships and mutual respect of a hierarchy in the community, that privileges breadwinners as mouth of instances for the whole household. Ancient farming tradition is extremely important also in influencing irrigation practices, that in turn affect power relationships that transcend the irrigation association itself, e.g. by reaching the local political level.
- 17 The decision-making process of the association presents no differences between the members cultivating their own land and the tenants. Every three years, all the regular members elect a formal board of representatives, which is responsible for the management of the whole commons. The main goal for the association is the provision of water for all the crop needs, along with the maintaining and the improvement of transportation and distribution facilities. The association draws its water from natural spring fountains that, at least in the past, were usually adequate to satisfy the irrigation needs.
- 18 Due to the overuse of the groundwater sources and to the end of the traditional crop rotation practices in favor of corn monoculture, the farmers have recently experienced a significant reduction of water availability. Similarly to the Vallée d'Aoste cases, a number of changes in the external context played a significant role in producing this outcome.

The association was created at the beginning of the twentieth century, when crops were combined and planted in rotation in order to maximize both soil fertility and yields. Farmers traditionally paid consistent attention to the water channels, that were cleaned monthly, and to the water patterns that were constantly monitored to make sure that excess water flowed into underground cisterns for future use. However, a shift occurred in the group's vision of their commons when, about two decades ago, the European Union started to subsidize corn. Following the resulting economic incentives, the association ended rotation practices and turned to monoculture. Whereas natural springs and streams had previously been sufficient for the irrigation needs, this new intensive farming led to a severe scarcity of water for all farmers. Moreover, the scarcity has been exacerbated by the incapacity of the association members to modify the existing institutional schemes (and especially the water allocation rules) in order to adapt to the new situation.

- 19 In this context, we conducted a research in order to analyze how the community attributes are involved in the process of institutional construction and institutional change for sustainable CPR management. According to Ostrom (2005), the main community attributes affecting the action arenas are the values shared among users, the level of common understanding that potential participants share (or do not share) about the structure of particular types of action arenas, and the extent of preference homogeneity among the community members. Our focus lays in the exploration of the relationship among reputation, trust and reciprocity, considered here individual values, and institutions, defined as the rules-in-use governing the resource. The research has been conducted using the IAD Framework (Fig. 2) as underlying scheme and opting for a qualitative method of data collection, which comprised in-depth interviews and the submission of semantic differential to a large share of the community members, including the association board members. We found that there is a strong relationship between the level of consciousness of the risk of overexploitation, the sensitivity for resource preservation, and the willingness to restrict water access during the dryer season. More generally, community members appear to be able to cope with scarcity only when they recognized the need to limit self-interest in the name of common goals.
- 20 A fundamental variable in the analysis is trust, both at the individual and at the group level. Especially important is the level of trust that the association members experiment toward the institution, i.e. independently from personal trust shared among its individual members. Trust develops only when the institution is preserved from the individual attempts to exploit it for private benefit, e.g. by manipulating the rules that govern the water rotation system and the irrigation time. In addition, we found that a widespread level of positive reputation is needed in order to sustain the trust network, especially in difficult times or in times of change (e.g. the shift from crop rotation to monoculture). By conducting a cluster analysis on our data, we found that three subgroups exist inside the community. They are mainly linked with different level of education and, more generally, with different capability to adopt long-term view of the purpose of the irrigation practice. The main result of the research is hence that, in order to achieve a sustainability of the institutional performance over time, the existence of a willingness to reciprocate among members and the subgroups is essential. However, reciprocity establishes mainly thanks to reputation, values and practices that spread mutual trustworthiness among all community members.

Discussion

- 21 The main goal of the paper, besides presenting the CPR theory and its application to irrigation systems, is to show the role that different social mechanisms play in influencing institutional performance for commons management. In our empirical analysis, we found a positive relationship between the achievement of sustainability of the institutional arrangement and the presence of a widespread body of shared values among community's members, which allows the groups to overcome the management limitations due to the underlying commons dilemma. Consistently with our study, a growing body of literature (e.g. Ostrom, 1990, 1998, 1999, 2005; Ostrom and Ahn, 2008) has recently shown that a successful CPR management implies an institutional construction able to take adequately into account, among the community attributes, the values shared among the resource users. Those values are indeed the vehicle of collective learning and the foundations of social order inside the community of users, as well as instruments of consciousness regarding the necessary institutional adaptation and flexibility.
- 22 Crafting institutions for governing irrigation systems is challenging and requires skills in understanding how rules produce incentives and outcomes when combined with specific physical, economic and cultural environments. According to Ostrom (1990) and Uphoff (1986), there is no "one best way" to organize irrigation activities, because rules governing the supply and use of any particular physical system must be devised, tried and modified over time. It is hence necessary to invest considerable time and resources in learning more about how various institutional rules affect the users' behavior. When institutions are well crafted, opportunism is substantially reduced. The temptations involved in free riding, rent seeking and corruption can never be totally purged, but institutions can be devised in order to hold those factors under control (Ostrom, 1992). In order to decrease opportunistic behavior, coordination activities such as monitoring and sanctioning may have to be increased. Lack of monitoring and sanctioning, unfair monitoring cost share and expensive arrangements for conflict resolution can all undermine the complex system of mutual expectations and commitments (Ostrom and Walker, 2003).
- 23 The costs of monitoring and sanctioning activities necessary to eradicate opportunistic behaviors are often not affordable for local communities of users, because controlling opportunistic behaviors involves both a reduction of "free-riding temptations" and a high likelihood of being discovered when transgressing a rule. In this process, common values and shared norms can make the difference, thanks to the establishment of internal commitment and punishment that push the actors to respect the rules in use and hence reduce the monitoring and sanctioning costs. Irrigation systems should hence devise workable procedures for the monitoring of the behavior of water suppliers and users, for the sanctioning of non-conforming behavior and for conflict-resolution. Where substantial temptation exists to engage in opportunistic behavior, no set of rules will be self-enforcing (V. Ostrom, 1980). However, our research found that the existence of a common set of values is extremely useful in increasing the institutional performance and in controlling free-ride behaviors. It is relatively easy to include this new variable in the IAD Framework thanks to the concept of social capital. Social capital is a concept encompassing those cultural, social and institutional aspects of a given community that jointly affect its capacity to deal with collective-action problems. Alternatively, it can be

viewed as an attribute of individuals that enhances their ability to solve collective action problems (Ostrom and Ahn, 2008). Social capital is usually the product of a past history of tight relationships and little social capital exists when large numbers of heterogeneous individuals act in an unknown situation.

- 24 A final point which is important to recognize is that genuine trustworthiness, i.e. the individual preferences consistent with conditional cooperation, is an independent and nonreducible reason for explaining how communities achieve collective action compliance. Among the variable involved, the one that creates the strongest links between social capital and collective action is trust. Trust is enhanced when individuals are trustworthy, are networked with one another and act within institutions that reward honest behaviors (Marshall, 2005). In accordance with Ostrom (1998), our findings suggest that in addition to learning instrumental heuristics, individuals learn how to adopt and use norms and rules from the group. Our results give also support Ostrom (1998, 1999) idea of a core relationship existing among trust, reputation and reciprocity. We found indeed that those factors are dependent from the community past experiences and from the capacity of its members to recognize a major common interest in preserving the resource. Once in place, those factors enhance in turn the capacity of a community to govern its commons and, especially, to foster the neverending process of institutional adaptation necessary for a long term sustainable management of natural resources (see Berkes et al., 2003).

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ABSTRACTS

Common-pool resources are natural or man-made resources shared among different users, a condition that produces a competition for their utilization leading often (although not necessarily) to their degradation or even to their destruction. This paper shortly discusses the "theory of the commons", as developed in the last 20 years by Elinor Ostrom and her colleagues, and illustrates it by mean of case studies regarding a number of irrigation systems in Northern Italy (Lombardy and Aosta Valley). We show that that different social mechanisms, like the shared values e the social network existing inside the community of users, play a significant role in influencing the outcomes of the institutional schemes for the commons management.

Les ressources communes sont des ressources naturelles ou artificielles partagées par différents utilisateurs ; l'exploitation de ces ressources crée une rivalité, souvent (mais pas nécessairement) à l'origine de leur dégradation, voire de leur destruction. Cet article présente brièvement la théorie des ressources communes développée ces vingt dernières années par Elinor Ostrom et ses collègues, et l'illustre par plusieurs études de cas de systèmes d'irrigation du nord de l'Italie (Lombardie et Vallée d'Aoste). Il démontre que différents mécanismes sociaux, tels que les valeurs partagées et le réseau social existant au sein de la communauté d'utilisateurs, influent sensiblement sur l'efficacité des systèmes institutionnels de gestion des ressources communes.

INDEX

Geographical index: Aosta, Brescia, Italy, Lombardy

Mots-clés: irrigation, mécanismes sociaux, ressources communes, valeurs partagées

Keywords: common-pool resources, irrigation, shared values, social mechanisms

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